Modern Concepts of Cardiovascular Disease

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Editor
HOWARD P. LEWIS, M.D.
Portland, Oregon

Associate Editor
HERBERT E. GRISWOLD, JR., M.D.
Portland, Oregon

Associate Editor
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Portland, Oregon

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PRESENT STATUS OF OPEN CARDIOTOMY FOR CORRECTION OF CONGENITAL AND ACQUIRED CARDIAC DISEASE*

The past decade has brought forth an impressive array of advances in the field of cardiovascular surgery. As recently as 1948, there were only three congenital cardiac lesions amenable to surgical treatment: patent ductus arteriosus, coarctation of the aorta, and the systemic-pulmonary artery anastomosis for the tetralogy of Fallot malformation. The interior of the heart was an important barrier to progress; it was the last anatomical frontier of the many that have confronted surgeons.

The development and introduction into routine clinical use of safe and effective methods of extracorporeal circulation for cardiopulmonary bypass has removed this barrier and opened a new era in the therapy of cardiovascular disease. A steadily growing variety of progressively disabling cardiac lesions, congenital and acquired, in many instances previously inoperable, have been successfully treated under direct vision by means of open cardiotomy utilizing extracorporeal circulation. This method has resulted in complete correction of many cardiac lesions previously considered incurable, as well as an improved and safer surgical treatment for the less remediable conditions.

At the time of this review, in mid-1957, more than 350 patients, ranging in age from six weeks to 66 years, have had operations utilizing extracorporeal circulation in the repair of cardiovascular lesions, congenital or acquired, at the University of Minnesota Variety Club Heart Hospital. From this clinical and experimental study, embracing periods of three and one-half and 10 years respectively, certain conclusions are possible. Concepts and techniques are bound to change with time, but the bold outline for likely future developments seems clear.

For the complex cardiac lesions which were incurable before the advent of extracorporeal circulation, little difference of opinion exists today about the choice of method for operation. On the other hand, some differences of opinion may still persist with regard to the procedure for intracardiac conditions, in which some improvement was possible by the use of indirect or blind

Table I

Cardiac Lesions Managed by Open Cardiotomy Utilizing Extracorporeal Circulation

A. Extracorporeal circulation procedure of choice —many patients treated
Ventricular septal defect (congenital, acquired)
Atrial septal defect
Tetralogy of Fallot
Atrioventricularis communis
Aortic pulmonary septal defect
Ruptured aneurysm of sinus of Valsalva
Total anomalous pulmonary venous return
Pulmonic stenosis, valvular or infundibular
Mitral stenosis (recurrent or advanced disease)
Mitral regurgitation
Aortic stenosis (congenital, acquired)
Left atrial myxoma
Ventricular aneurysm
Thoracic aortic aneurysm
B. Application of extracorporeal circulation in a developmental state -- relatively few patients treated
Single ventricle
Aortic regurgitation
Coronary arteriosclerosis
Complete transposition of the great vessels
Ebstein's malformation

*From the Department of Surgery and Variety Club Heart Hospital, University of Minnesota Medical School, Minneapolis, Minnesota.

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methods of surgical treatment. Physicians will find that time and total experience are the best arbiters of whatever uncertainties may exist. The only worthy objective is the patient's welfare, which means the treatment that is likely to yield the best results (a cure, if possible) at the lowest risk. Economic factors (such as fewer operations a day for the surgeon), special equipment or assistance required, and more work for the blood bank and other personnel, are not to be considered significant when human life and happiness are at stake. These temporary obstacles can be overcome by initiative, perseverance, planning and organization.

Thus the pump-oxygenator, permitting a direct vision approach, is now deemed the method of choice for a large number of cardiac lesions severe enough to warrant operative management (Table I).

Ventricular Septal Defect

There is now little question that it is desirable to close all ventricular septal defects associated with any significant degree of shunt, and particularly with pulmonary hypertension (the vast majority). Ventricular defects are common congenital cardiac malformations, probably ranking first in incidence and exceeding even patent ductus arteriosus. The malformation generally has been lethal.

Of all patients born with a ventricular septal defect in the days prior to corrective surgery, more than 95 per cent died prematurely. The attrition rate was particularly high during the first year of life, approaching 50 per cent in some series. The latter figure, however, may have been disproportionately high. Now that the defect is curable, both physicians and parents have been stimulated to treat some of the death-dealing complications more successfully by medical methods. Surgical therapy, however, is available for those infants not responding to this treatment.

An isolated ventricular septal defect is rarely found in older patients beyond their teens. In the author's experience, a number of the older patients believed for years to have a ventricular septal defect or Eisenmenger's complex, have proved upon surgical exploration to have some other variant of heart disease. The conclusion is inescapable that few patients born with an isolated ventricular septal defect survive beyond the pediatric age without corrective surgery.

The lethal element of a ventricular septal defect is, primarily, the early rapid and progressive development of pulmonary hypertension associated with pulmonary arteriosclerosis. The potent stimulus to these arteriolar changes in the lungs is not the increased blood flow through them (patients with atrial secundum defects as a group have left to right shunts of a far greater magnitude than do those with ventricular defects, although the onset of pulmonary hypertension is late), but rather the fact that the pulmonary vasculature is exposed freely to the systemic pressure, because each systolic thrust of the left ventricle can be imparted relatively undamped to the lung vessels through the defect.

Indications for Reparative Surgery

The indications for closing a ventricular defect are many and the contraindications few. The operative risk for closure of a ventricular septal defect in a patient with mild to moderate pulmonary hypertension (up to 70 per cent of the systemic pressures) is, in the hands of an experienced surgical group, very low (2 per cent). Therefore, once a group has perfected its surgical and perfusion techniques, the same indications should prevail as are currently accepted for the division of a patent ductus arteriosus.

Undue procrastination about an operation during early childhood pyramids the risk, for the pulmonary artery pressures in some patients can double within 12 months. It is true that in some patients the pulmonary pressures may not change over many months or even years, but there is no present or foreseeable future way of separating these two groups, *a priori.*

The onset of severe pulmonary hypertension is an ominous sign, and although correction is still indicated, the most favorable moment for this surgery may have passed. In our earlier experience, most of the patients referred for corrective surgery had advanced degrees of pulmonary hypertension. Thus, we concentrated study upon the decisive physiological readjustments of the circulation necessary after correction of the anatomical defects.

Undoubtedly the risk of corrective surgery in patients with high pulmonary resistance is considerably increased. However, what was once a most discouraging field has responded well to the special measures which aid the pulmonary and cardiac readjustments necessary in the immediate postoperative interval. Four patients in the series (Table II) had pulmonary systolic pressures of over 100 mm. Hg. In those patients that have severe pulmonary hypertension and undergo corrective surgery, the special measures for aiding postoperative readjustments, to be of value, must be instituted before right heart failure and inadequate cardiac output, with all of their disastrous sequelae, have become established.

A majority of children that have advanced pulmonary arteriolar intimal proliferation, proved by lung biopsy, have had normal, or near normal, pulmonary artery pressures when recatheterized one to two years after successful closure of their ventricular septal defects. This indicates the obvious value of the great efforts made to guide them successfully through the crucial immediate postoperative interval.

Some clinicians have stated that when the electrocardiogram reveals no evidence of left ventricular enlargement, but reflects mainly right

Table II

Results in Last Forty Open Intracardiac Operations Consecutively Performed Utilizing Total Cardiopulmonary Bypass

University of Minnesota 1957

Lesion	Procedure	Duration of perfusion (min.)	Pts. No.	Mortality
Ventricular septal defect	Closure	12–40	14*	0
Tetralogy of Fallot (all cyanotic)	Complete correction	38–80	10*	1
Atrial septal defect	Closure	16–29	8	0
Aortic stenosis				
(congenital valvular)	Valvotomy	12–20	2	0
(congenital subvalvular)	Excision stenosis	13½	1	0
Mitral regurgitation (rheumatic)	Valvular reconstruction	22–29	2	0
Isolated infundibular pulmonic stenosis	Excision stenosis	16	1	0
Atrioventricularis communis	Complete correction	50	1	0
Single ventricle	Insertion of septum of Ivalon	62	1*	0
	Total		40	1 (2.5 per cent)

*Seven of these patients sustained complete heart block and all were successfully managed by the myocardial electrode and the external pacemaker during the interval until sinus rhythm returned.

ventricular hypertrophy, the condition is "inoperable." In a study of the preoperative electrocardiograms of our patients already operated upon, we found that whereas rigid application of these criteria would have prevented some deaths, it also would have eliminated a substantially larger number of successes. Thus, in the first patients who survived corrective surgery for ventricular septal defect (using cross circulation, in most cases), in whom cardiac recatheterization later had been carried out, there were 21 who had no shunt, and pulmonary arterial pressures had fallen 30 per cent or more below their preoperative levels in the interval of four to 20 months between corrective surgery and postoperative recatheterization. All 21 of these patients, therefore, can be considered to have had a favorable response to a proved complete closure of their ventricular defects. It is pertinent that 19 preoperatively had an "inoperable" electrocardiogram. Thus, whereas the precordial lead electrocardiogram offers a good deal of physiological information, we believe that, utilizing the presently known criteria, it is far too sensitive an index for predicting operability without taking into consideration many other factors.

Because ventricular septal defects are common, and since many cause considerable trouble early in life, one sees a number of infants rather desperately ill of this condition. They suffer from a failure to gain weight, repeated respiratory infections, and recurrent or persistent cardiac decompensation. Virtually all have severe pulmonary hypertension. We consider these infants in urgent need of surgical relief, but recognize their increased operative risk; however, they often are destined for early death unless successfully operated upon. In our series of 172 patients undergoing corrective surgery for ventricular septal defects, we have operated upon 52 under the age of two years. On the other hand, in the case of an infant with a ventricular septal defect, gaining weight at a relatively satisfactory rate and appearing to respond well to nonoperative management, we prefer to postpone surgery, if possible, until at least the age of two years. The technical aspects of the defect closure during infancy are not excessive. The major hazards hinge on the management of respiratory complications.

Some infants that progress poorly at home, even under ideal conditions, do remarkably better in the hospital with its more controlled regimen.

This suggests a use that some of our empty tuberculosis sanitoriums might have if they were converted in part to centers for the interim care of patients with congenital heart disease.

Atrioventricularis Communis

Although less common (22 patients encountered in the first 360 subjected to open cardiotomy) than ventricular septal defects, it is well documented that patients born with these defects are usually seriously ill and have a severely shortened life expectancy.

Corrective surgery for this malformation is now feasible. The anatomy of these defects may be complex and their pathological variations many. The complete form, encountered in about half of our patients, consists of an ostium primum atrial septal defect, mitral regurgitation due to a separation in the aortic leaflet of this valve, tricuspid insufficiency because of a similar deformity of the septal leaflet, and a ventricular septal defect due to a failure of these leaflets to attach completely to the ventricular septum. It is found most often in infants, and usually leads to the early development of severe pulmonary hypertension and serious clinical disability. The first patient to have an atrioventricularis communis syndrome that was corrected successfully was an infant operated upon in 1954, utilizing controlled cross circulation. This child is normal three years postoperatively, is without a shunt, and has a normal pulmonary artery pressure of 20/4 mm. Hg (90/50 mm. Hg preoperatively) measured by recatheterization. The partial type consists of an ostium primum defect associated with a cleft mitral valve, normal tricuspid valve and no ventricular component.

Three patients had a rather atypical form in which a left ventricular, right atrial shunt arose through a defect between these two chambers, with the left atrial wall remaining intact. All had valvular deformities. It would appear that these patients represented an embryological variant of this same syndrome. One patient only had an ostium primum without apparent valvular deformity.

The atrioventricularis communis group of defects cannot be corrected by blind or closed methods, or even with direct vision under hypothermia. A perfusion method at normal body temperature is essential. This allows precise suturing and cure becomes possible. Repair consists of closure of the septal defects (a compressed polyvinyl patch is often needed) together with careful correction by suture of the valvular malformations.

Atrial Septal Defects

The only acceptable treatment for an atrial secundum septal defect is one that produces a cure. It follows, therefore, that the results of all forms of treatment, closed or open, must be appraised after postoperative catheterization. An initial low mortality, while obviously desirable, is not at all meaningful in the ultimate evaluation of the best method of treatment if a significant percentage of the patients is not cured. Evaluation has been obscured for some cardiologists because of lack of appreciation of the fact that most patients with atrial secundum defects, unlike those afflicted with ventricular septal defects and other more serious malformations, will survive a thoracotomy and exploratory cardiotomy even though the abnormal opening may not have been completely closed nor even substantially narrowed. Advocates of the closed methods for "repairing" atrial septal defects have rarely presented catheterization data obtained postoperatively. Moreover, the little information that is available reveals a substantial incidence of residual shunts.

Another consideration is the difficulty in distinguishing preoperatively in all cases between atrial secundum defects and the various forms of the ostium primum syndrome. Although many authors have described valuable criteria for making this differential diagnosis, accurate differentiation is not always possible, even for a diagnostician of considerable skill and experience. In a certain number of patients, when utilizing hypothermia or one of the above-mentioned blind techniques for closure of atrial septal defects, the surgeon will find himself in the operating room with the patient's chest open and at the mercy of the more complicated pathology unexpectedly found to be present.

These considerations are sufficiently vital to the patient's well-being to advocate using total cardiopulmonary bypass with the pump-oxygenator for repair of all atrial septal defects. The dividends of this policy have been numerous. First, in a substantial series of patients, ranging in age from two to 51 years with atrial secundum defects, there have been no deaths. The ability to close even these simple defects in an unhurried and precise manner with interrupted stitches indicates that the percentage of anatomical cures may be expected to approach 100 per cent. Second, we have been able to repair with ease the unexpected and complicated defects not satisfactorily approachable by other methods.

Other cardiologists and surgeons, as they acquire confidence in their pump-oxygenator, will no doubt abandon the less effective methods that have been used in the past for closure of atrial septal defects.

Partial and Total Anomalous Pulmonary Venous Return

It has been uncommon for partial anomalous venous return to exist without at least a patent foramen ovale; more often it is associated with a secundum type of atrial septal defect.

Obviously, all instances of total anomalous venous return require the coexistence of an atrial shunt. The operative management of this anomaly is, therefore, uniformly complicated by the pres-

ence of an atrial septal defect. Since ideally the latter can only be corrected by direct vision intracardiac reparative surgery, the plan of management for anomalous venous return is, in a sense, a secondary consideration. In the partial types, the problem is often no more complicated than closure of the atrial septal defect, so that one or more of the abnormally placed pulmonary veins will be transposed to the left atrial chamber where they should be. Occasionally, isolated pulmonary veins will empty high and directly into the superior vena cava. With the routine use of cardiopulmonary bypass techniques, this cava may be partitioned (using a prosthesis of compressed polyvinyl sponge, if necessary) so that the different venous returns can be made to empty unimpeded into their proper atria at the same time an atrial defect is corrected.

Most forms of total anomalous pulmonary venous return additionally are associated with a hypoplastic left atrium, mitral valve, and left ventricle. This is particularly true of those cases where the entire pulmonary venous return from both lungs drains into the superior vena cava, coronary sinus, or portal vein circuit, and there is a relatively limited opening in the atrial septum. Under these circumstances, an excessive recirculation through the pulmonary circuit exists and a restricted flow moves into the left side of the heart. The latter chambers are very underdeveloped.

Complete correction in one stage, by bypass techniques, is the desirable goal and has been successfully accomplished in our series. However, when the entire pulmonary venous return is abruptly directed into the left atrium and the septal defect closed, great care must be exercised in the management of blood replacement and the administration of fluids at operation and immediately postoperatively if fatal pulmonary edema is to be avoided.

Tetralogy of Fallot

The development of visual intracardiac surgical techniques has substantially altered the management of the tetralogy of Fallot malformation formerly treated by a shunt procedure.

The palliative anastomotic operations of Blalock and Potts, previously the principal means of benefiting individuals crippled by Fallot's tetralogy, have been replaced at this center by curative operations carried out by open heart surgery utilizing the cardiopulmonary bypass. The same transition is in progress elsewhere.

In the beginning, due to the learning phases inherent in the development of a completely new operative approach for a complex defect, the operative risk was higher for the complete correction than for the palliative procedure. This is no longer true.

Moreover, the end results with the curative procedure are far superior. The oxygen saturation of the systemic blood becomes normal and the right ventricular pressure drops to normal without a gradient or with only a small gradient across the infundibular or valvular area in the pulmonary artery. Exercise tolerance becomes normal and for the first time the possibility of a normal life span becomes a reality.

On the other hand, the reasons for the continuing attrition among tetralogy cases treated by a shunt operation are fourfold, at least: First the small child recovering from an anastomotic operation designed to relieve the insufficient pulmonary flow associated with Fallot's tetralogy regularly may be expected to outgrow the essential effect of this shunt. He thus becomes progressively crippled by this limitation with the passage of time, and although his death is postponed a few years, he does succumb prematurely from pulmonary decompensation manifested by a rising hematocrit, vascular thromboses, or other consequences of chronic anoxia. Second, although his life has been prolonged, no increased protection has been provided against death from bacterial endocarditis arising adjacent to the shunt, or from a brain abscess to which he is particularly vulnerable because of the right to left shunt at the level of the septal defect. Third, if the initial shunt is made disproportionately large and greater than the cardiac reserve can tolerate (a situation more likely to occur in aorticopulmonary anastomoses), recurrent bouts or chronic cardiac decompensation may supervene. Last, if the patient with a shunt has survived into the present era of open heart correction of this defect, this operation must eventually be undertaken under more difficult circumstances (and higher risk) because of the previous palliative surgery.

Experience with the problems of hemostasis in patients who have been heparinized and who have had these vascularized adhesions (established after a previous shunt operation) removed as a preliminary to a bypass operation, has led to the belief that elective anastomotic operations for tetralogy of Fallot patients are undesirable now. Thus, the role of the shunt operation at this time appears to be twofold: first, as a life prolonging technique for gravely ill children with Fallot's tetralogy in those areas where curative surgery by direct vision methods is not yet available and postponement of surgical treatment seems impossible; and second, for certain lesions (tricuspid atresia, transposition of the great vessels with pulmonary stenosis) in which with present knowledge the malformation remains incurable. Under these circumstances, the establishment of a satisfactory systemic artery-pulmonary artery shunt can be an effective means of achieving palliation, and although normal life expectancy is not likely, the procedure may provide a longer life and certainly a more pleasant one.

The curative operation may be carried out at any age. In our series of patients now approxi-

mating 100 who have had this operation, the youngest (16 weeks) and the eldest (48 years) patients were operated on successfully. When the decision for surgical treatment is entirely elective, we prefer to wait until the child is at least two years of age.

Pulmonary Outflow Tract Obstruction with an Intact Ventricular Septum

Outflow tract obstruction is due either to stenosis of the valve, of the infundibulum, or of both. Involvement of the valve is the cause in most cases, although in many of these, because of the secondary hypertrophy associated with an increased work load on the right ventricle, there is an encroachment by enlarged trabecular fibers and an oversized crista supraventricularis into the outflow channel of the right ventricle.

Surgeons dealing with this problem have had legitimate differences of opinion, namely, whether to correct these lesions under direct vision, or to attempt to restore a more normal opening by indirect approaches (Brock, Sellors). However, direct vision surgery, limited to an operation on the valve and carried out through an opening in the pulmonary artery (as under hypothermia), is no longer indicated. Since no relief of any outflow tract obstruction in the subvalvular area has been added and it is not possible to cope with unanticipated septal defects, the closed (transventricular) operation of Brock is probably as good and also safer.

With the continuing reduction in the risk, due to a better understanding of the physiology of the extracorporeal circulation, we now favor cardiopulmonary bypass for routine use in all patients with pulmonic stenosis involving either infundibular or valvular regions. Not only does this method permit satisfactory visualization and precise repair of the pathological anatomy in the outflow tract at a low risk, but virtually all possible associated defects can be dealt with satisfactorily, whether they have been adequately diagnosed preoperatively or not.

Ruptured Aneurysm of Sinus of Valsalva

Rupture of an aneurysm of the sinus of Valsalva into one of the cardiac chambers results in a left to right shunt with a reduced diastolic pressure in the systemic circulation. The characteristic murmur and hemodynamic findings make the diagnosis relatively straightforward. Until recently, persons suffering from this lesion either died prematurely or were incapacitated from their progressive cardiac decompensation. In the past year and a half, three patients with this malformation, ranging in age from 10 to 37 years, have been operated upon utilizing the pump-oxygenator; the results of corrective surgery have been successful in all.

Acquired Heart Lesions

Rapidly increasing experience with the pump-oxygenator in the treatment of congenital cardiac malformations has resulted in confidence concerning the well-being of the patient during an interval of total cardiopulmonary bypass. The open operation has been extended to acquired lesions of the aortic and mitral valves customarily treated by blind or closed techniques.

Moreover, for the first time a definitive corrective procedure for those patients suffering from mitral regurgitation has become available, and the promise of a similar accomplishment for those afflicted with aortic regurgitation is offered by these direct vision techniques.

Mitral Regurgitation

Under direct vision and with the pump-oxygenator, we have operated upon a series of patients incapacitated preoperatively by pure mitral regurgitation. Excellent surgical exposure of the mitral valve was secured through a unilateral right thoracotomy and a left atriotomy. Valvular function was restored by annuloplasty when annular dilatation was present, and by insertion of synthetic mitral leaflets when loss of valve substance predominated. All patients recovered from surgery and were impressively improved in a follow-up period now exceeding one year for the first patients.

Mitral Stenosis

The patient with pure mitral stenosis may be benefited by a carefully performed mitral commissurotomy, using the indirect or blind techniques classically described by Bailey, Harken, and others.

The principal problems remaining in this field for cardiac surgeons are these: (1) the much higher operative risk of commissurotomy performed in clinically far advanced states of disability (Stage IV); (2) embolization prior to or at the time of surgery; (3) patients with apparent restenosis after a seemingly adequate valvuloplasty; (4) cases where there is suspected or significant mitral regurgitation; and (5) patients with multivalvular disease.

At present, these are the indications for an open operation upon the mitral valve on the author's service. Direct vision surgery upon the mitral valve carried out through right thoracotomy and left atriotomy, utilizing the pump-oxygenator, has been a very satisfactory procedure with a low risk. As a result, we have found ourselves progressively widening the indications for open operation.

Aortic Stenosis

Usually, diagnosis is not difficult; the main issue in any particular case is the need for operative relief and the risk involved for that individual.

To delay operation until syncope, angina, and recurrent heart failure exist is to forfeit the best chance of surgical help. Moreover, the occurrence of a left ventricular strain pattern in the electro-

cardiogram is a late as well as ominous development, and sudden death may intervene before this sign has appeared. On the other hand, murmurs and thrills over the aortic area, which appear to be significant, may occur with unimportant pressure gradients not requiring surgical treatment.

Thus, the use of left heart catheterization in questionable cases is certainly valuable in establishing more accurate criteria for recommending an operation, and for evaluating the results.

In the acquired calcific lesions, some difference of opinion continues to exist between those advocates of closed methods and those who endorse the direct vision type of operation. This is recognition of the fact that an imperfect valvuloplasty may be the best that can be done at present in some of the heavily calcified lesions, even by direct vision techniques.

For the past one and one-half years, the author has carried out all operations for calcific aortic stenosis under direct vision, utilizing the pump-oxygenator. This has demonstrated that a greater number of patients can be helped at a lower risk by the increased scope and accuracy that vision permits, even though failures may occur and are even likely in certain patients with completely destroyed valves. The experience gained with procedures under direct vision in this relatively restricted area has already resulted in progressively better techniques for aortic valvuloplasties. It is certain to stimulate the development of satisfactory prosthetic replacements, and prove invaluable in developing the methods (retroperfusion of the coronary sinus) for their insertion proximal to the coronary arteries. This should make possible truly curative surgery for nearly all patients with this affliction in the immediate future.

For congenital aortic stenosis the problem is less complex. Virtually all surgeons agree, at present, that open techniques are preferable. In these patients the aortic leaflets, although often indeterminate in number, are pliable and free of calcium, so that relief of stenosis is possible with little risk of insufficiency and thereby a low operative risk.

Results

In this relatively brief review, the conclusions are based upon experience gained in open cardiotomy utilizing extracorporeal circulation at normal body temperature. Our series of patients have had a wide variety of disabling cardiac lesions, both congenital and acquired in origin. In many instances, efforts were directed primarily toward the correction, and even cure of previously inoperable lesions. As a consequence, many of the patients were critically ill prior to surgery. Patients with lesions which may be corrected we believe deserve the potential benefits of surgical treatment, even though the calculated risk may be high in some far advanced and seemingly hopeless clinical conditions.

In the beginning of this series, operative risk was understandably higher for most conditions. A number of factors contributed. The apparatus, techniques, and knowledge of the physiology of total body perfusion in man had to be developed. In addition, a number of new surgical procedures had to be devised and tested. Moreover, much learning was necessary by the inevitably painful method of trial and error. The *in vivo* problems of unfamiliar or poorly described pathological malformations demanded on the spot improvisations, which naturally did not always succeed the first time. These facts are, of course, paramount in evaluating the successes obtained as well as the failures recorded. Nonetheless, the risks even during this beginning period were found to be well worth taking when examined in terms of the significant improvement, in many cases, of otherwise hopeless conditions. For example, of the 27 patients with ventricular septal defects operated upon in 1954 by controlled cross circulation, 19 survived, and of the eight deaths, six were in infants.

In these 360 patients, ranging in age from six weeks to 66 years, the majority are completely cured thanks to the accuracy that visual methods give to surgical technique. In addition, a study of the failures, early and late, has led to a steady reduction of operative risk for open heart surgery to its present low levels. Thus, in the last 40 consecutive patients operated upon out of this series of 360 undergoing open cardiotomy upon the author's service, there has been only one death, or a mortality rate of 2.5 per cent.

C. Walton Lillehei, Ph.D., M.D.
Professor, Department of Surgery and Variety Club Heart Hospital
University of Minnesota Medical School
Minneapolis, Minnesota

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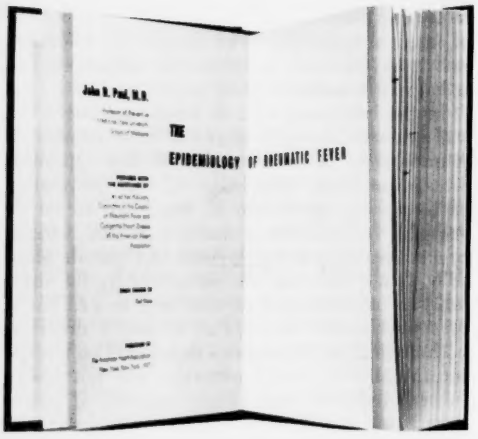

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The 31st Annual Scientific Sessions of the American Heart Association will be held in San Francisco, California, on October 24 through 26, 1958, at the Association's Annual Meeting. Abstracts will be accepted only on special forms which can be obtained from Dr. Frederick J. Lewy, American Heart Association, Inc., 44 East 23rd Street, New York 10, New York.

Papers intended for presentation should be based on original investigations in or related to the cardiovascular field. Abstracts must not exceed 250 words and should contain, in summary form, results obtained and conclusions reached. They must be submitted in triplicate, in a form suitable for publication, without editing, in the Proceedings. *The deadline is June 13, 1958.*

Abstracts which arrive late, or are longer than 250 words, cannot be considered.

The Scientific Sessions again will feature a section for Scientific Exhibits. Space may be requested only on application forms which can be obtained from the address above. *The deadline for these applications is June 13, 1958.* They will be submitted for decision to the Committee on Scientific Sessions Program of the Association.

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